KENWOOD

SERVICE MANUAL

SM-220

STATION MONITOR

SAFETY NOTICE

The following explicit definitions apply in this manual;

NOTE	If disregarded, inconvenience only—no risk of equipment damage or personal injury.
CAUTION	Equipment damage may occur, but not personal injury.
WARNING	Personal injury may occur—DO NOT DISREGARD!

WARNING

HIGH VOLTAGES PRESENT

Observe all standard safety procedures regarding high RF, AC, and DC potentials.

HIGH VACUUM CRT

The CRT (cathode ray tube) contained in this instrument is a high vaccume device, breakage of which may cause high velocity scattering of glass particles. Rough handling of the instrument, and especially the CRT, is to avoided.

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SECTIONI 1. SPECIFICATIONS

CRT75ARB31

Phosphor	B31
Colour	Blue-Green

TRANSMIT SIGNAL MONITOR TERMINAL

Frequency range	1.8 ~ 150 MHz
Maximum power	1.8 ~ 54 MHz (2 kW/PEP) 150 MHz (200 W/PEP)
SWR	1.2 or less
Deflection sensitivity	More than 1 DIV at 2 W/PEP input
Attenuator	6 steps

TRAPEZOID WAVEFORM OBSERVATION

Frequency range	1.8 ~ 30 MHz
Maximum power at DRIVE terminal	100 W/PEP
SWR	1.2 or less

TWO-TONE GENERATOR

Oscillator frequency	1,000 Hz 1575 Hz or both switchable
Output voltage	10 mV/50kΩ (at TWO TONE)

PAN DISPLAY

Adaptor name	BS-5 (TS-520 series), BS-8 (TS-820 series)
Input center frequency	3,395 MHz (BS-5), 8,830 MHz (BS-8)
IF frequency	455 kHz
IF bandwidth	More than 1 kHz (−6 dB)
Input sensitivity	More than 20 dB μ/DIV
Scan width	±20 kHz, ±100 kHz, selectable

HORIZONTAL AMPLIFIER

Gain adjustment	100B (Approximate)
Deflection sensitivity	More than 300 mV/DIV
Frequency response	DC-250 kHz or greater (EXT GAIN at MAX) DC-40 kHz (EXT GAIN at 1/2)
Input resistance/capacity	1 MΩ (±20%), 40 pF or less (SYNC switch at INT)
Attenuator	Fully variable to 0
Max. input voltage	100 Vp-p

SWEEP CIRCUIT

Sweep frequency	10 Hz ~ 100 kHz (in 4 ranges, variable)
Sweep linearity	Better than 5%
Sync system	Synchronized sweep, internal negative sync and external sync
Sync maplitude	Internal .... More than 1 DIV on CRT External ... More than 2 Vp-p

VERTICAL AMPLIFIER

Deflection sensitivity	More than 20 mV/DIN
Frequency response	2 Hz ~ 10 MHz (−3 dB)
Input resistance/capacity	1 MΩ, 40 pF
Overshoot	Less than 5%
Attenuator	1, 1/10, 1/100 and GND/MONITOR (Error between steps: 5% max.)
Max. input voltage	300V (DC+AC peak) or 600 Vp-p

POWER SUPPLY	AC 117V ±10%, 50/60 Hz, 20W
DIMENSIONS	215(W) × 153(H) × 335(D) mm
Weight	5 kg

ACCESSORIES SUPPLIED

Instruction book	1
VHF type cable	1
Tone output cable	1
Auxiliary feet (with screws)	2
Warranty card	1

Specifications are subject to change without notice due to technical improvements.

SECTION 2. FEATURES

1. The SM-220 Station Monitor is specially designed for the TS-820 and TS-520 series SSB transceiver.
2. The SM-220 functions as monitor scope, oscilloscope and two-tone oscillator. An optional Pan Display scope function is available.
3. Transmit waveform from 1.8 ~ 150 MHz can be observed with the monitor scope. Applicable power levels: 2KW PEP to 54 MHz, 200W PEP to 150 MHz. Drive input/output terminals allow trapezoid waveform observation of a linear amplifier.
4. Oscilloscope sensitivity is 20 mV/div (min), and bandwidth is 2 Hz ~ 10 MHz (min). Further, the IF waveform of the TS-820/S receiver section can be directly observed from the IF-OUTPUT terminal.
5. Two Wien bridge oscillators generate 1000 Hz and 1575 Hz tone, available individially or simultaneously.
6. Optional Pan Display units available:
   The BS-8 for TS-820 series transceivers.
   The BS-5 for TS-520 series transceivers.
7. Horizontal trace tilt can be adjusted from the rear of the unit without removing the case.
8. The blue-green phosphor (B31) CRT assures excellent brightness and contrast.

SECTION 3.CRT SPECIFICATIONS

Dimensions	
Total length	250 ± 6 mm
Max. diameter	76 ± 2 mm
Heater	
Voltage	6.3V
Current	0.3A
Maximum	
Plate 2 voltage (Eb2)	2750V
Grid 2 voltage (Ec2)	2750V
Operating Characteristics	
Plate 2 voltage (Eb2)	1500V
Focus voltage (Eb1)	75 ~ 300V
Grid 2 voltage (Ec2)	1500V
Blanking voltage (EcO)	−28.5 ~ −67.5V
X-axis deflection factor	23.1 ~ 29.1VDC/cm
X-axis deflection factor	13.7 ~ 18.2VDC/cm

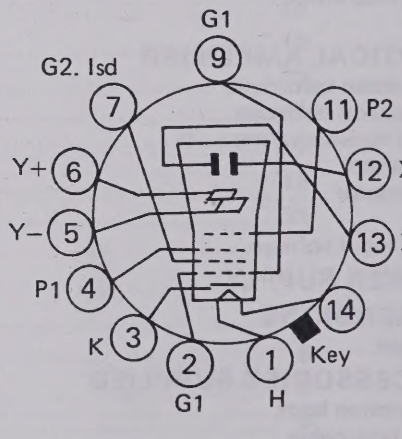


Fig. 3-1 75ARB31 Basing

SECTION 4. BLOCK DIAGRAM

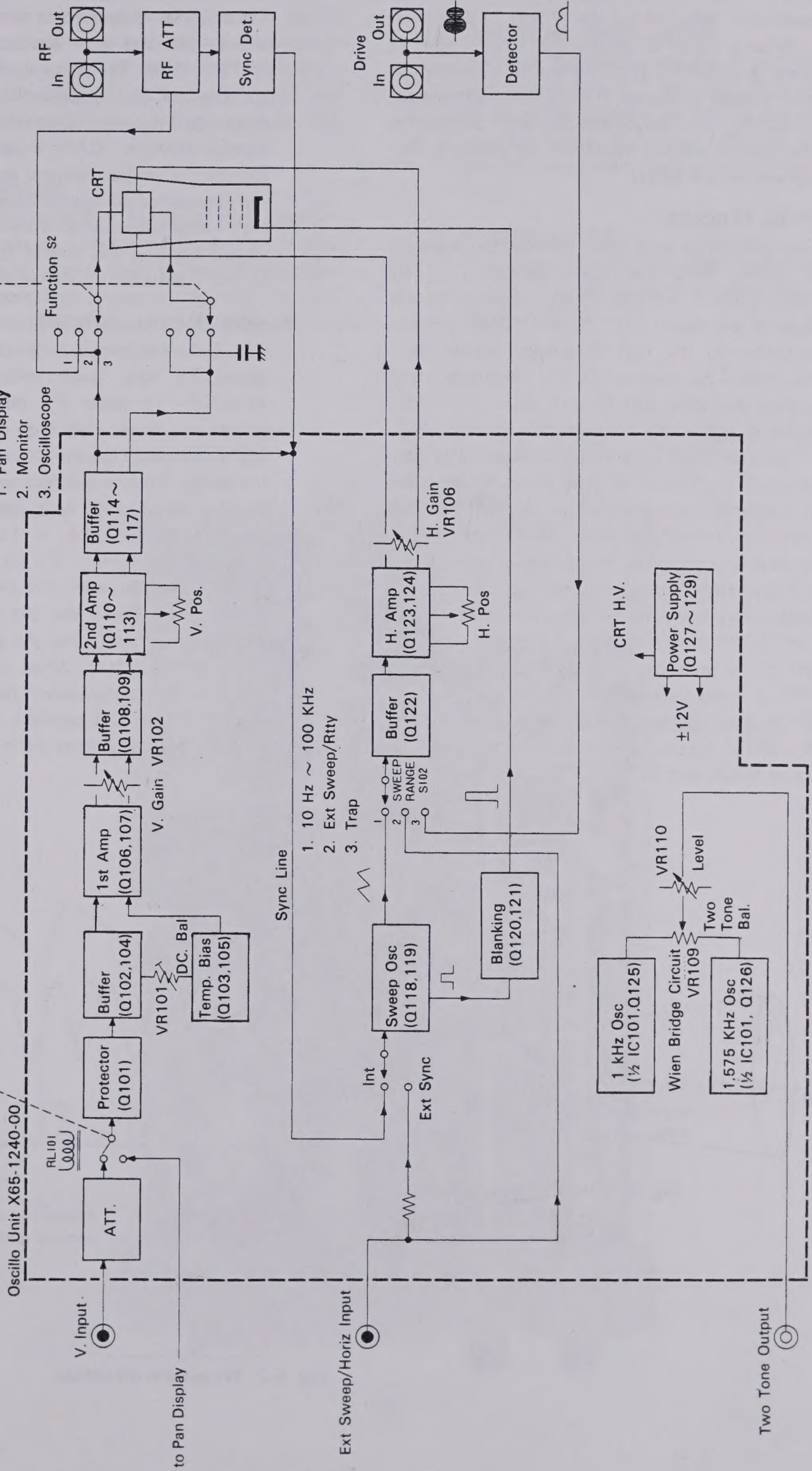


Fig. 4-1 SM-220 (Block Diagram)

SECTION 5. CIRCUIT DESCRIPTION

1. THEORY OF OSCILLOSCOPE DISPLAY

Fig. 5-1 shows the principle of oscilloscope display. Electrons emitted from the cathode of the CRT and electrostatically defected by the X and Y deflection plates. When a signal to be observed (a sine wave in this figure) is applied to the Y deflection plates and a saw tooth voltage is applied to the X deflection plates, the high voltage accelerated electron beam strikes the phosphor screen and the waveform (as shown in Fig. 5-2 appears on the screen.

2. VERTICAL CIRCUIT

When the SM-220 is used as an oscilloscope, signal is applied to the V. INPUT and may be devided 1/1, 1/10 or 1/100 by the V. ATTENUATOR, according to the amplitude of the signal. TC101 and TC102 provide compensation of the high frequency signal components, which are lowered by the attenuator input capacitance, and stray capacitance of the amplifiers. The signal is applied to the protection circuit Q101, and the gate of Q102 via a switching relay. The gate current of Q101 begins to flow when signal peak voltage becomes less than −13V, so that Q102 is protected from breakdown.

A buffer consisting of Q102 and Q104 is combination source follower and emitter follower, so a high input impedance and a low output impedance are achieved. Q106 and Q107 form a differential amplifier, the gain of which can be varied in the range of 22 dB by VR102 (V. GAIN), bridged between the two emitters. Q103 and Q104 bias the amplifiers against temperature change. VR101 adjusts the DC Balance between the emitters of Q104 and Q105. Of the emitter voltages are unbalanced, this difference is amplified and as the V. GAIN is adjusted the trace moves from the center of the screen. The signal, amplified by Q106 and Q107, 1st amplifier is applied to the emitter follower Q108 and Q109, and then applied to the 2nd amplifier, Q110 ~ 113. The 2nd amplifier is cascoded, and exhibits good high-frequency characteristics. TC103 corrects high-frequency response, and VR103 adjusts the Vertical Position. Q114 through Q117 form a complementary emitter follower amplifier, whose low output impedance decreases the affects of deflection plate high frequency loading. When the SM-220 is used as an oscilloscope, this emitter follower output is applied to the Y deflection plate of the CRT.

3. HORIZONTAL CIRCUIT

The horizontal circuit consists of a Sweep Oscillator generating saw tooth voltage, and a Horizontal Amplifier. To make the display stationary on the screen, the sweep frequency must be 1/N of the input signal frequency (as shown in Fig. 1, N = 2). That is, the sweep must be synchronized with the input signal. For this purpose, the sync signal is picked-off the vertical amplifiers Q114 ~ 117, and applied to the sweep oscillator Q118, Q119. The S4b SYNC/MARKER switch INT (internal or EXT (external) sync signal. When the SM-220 is used as an oscilloscope with INT sync, the sweep synchronizes with the V. INPUT signal. When used as a MONITOR, the sweep is synchronized with the modulated transceiver output. In the EXT position, the sweep synchronizes with a signal applied to the H. INPUT/EXT. SYNC terminal.

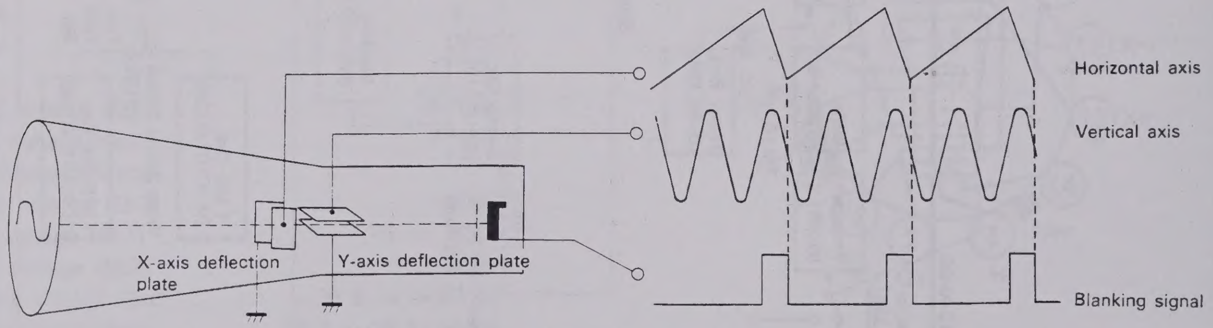
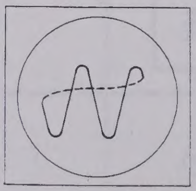


Fig. 5-1 Oscilloscope theory



Broken line doesn't appear because of blanking signal.

Fig. 5-2 Waveform on screen

SECTION 5. CIRCUIT DESCRIPTION

Saw tooth voltage generated by the sweep oscillator is amplified by the horizontal amplifier Q112 ~ 124, and applied to the X deflection plates. When the SWEEP RANGE selector is placed in the EXT position, the H. INPUT/EXT SYNC signal is applied to the horizontal amplifier after attenuation by the SWEEP VAN/EXT. GAIN control. VR-106 (H. GAIN) sets varies the horizontal amplifier gain so the trace extends fully across the screen.

4. MONITOR CIRCUIT

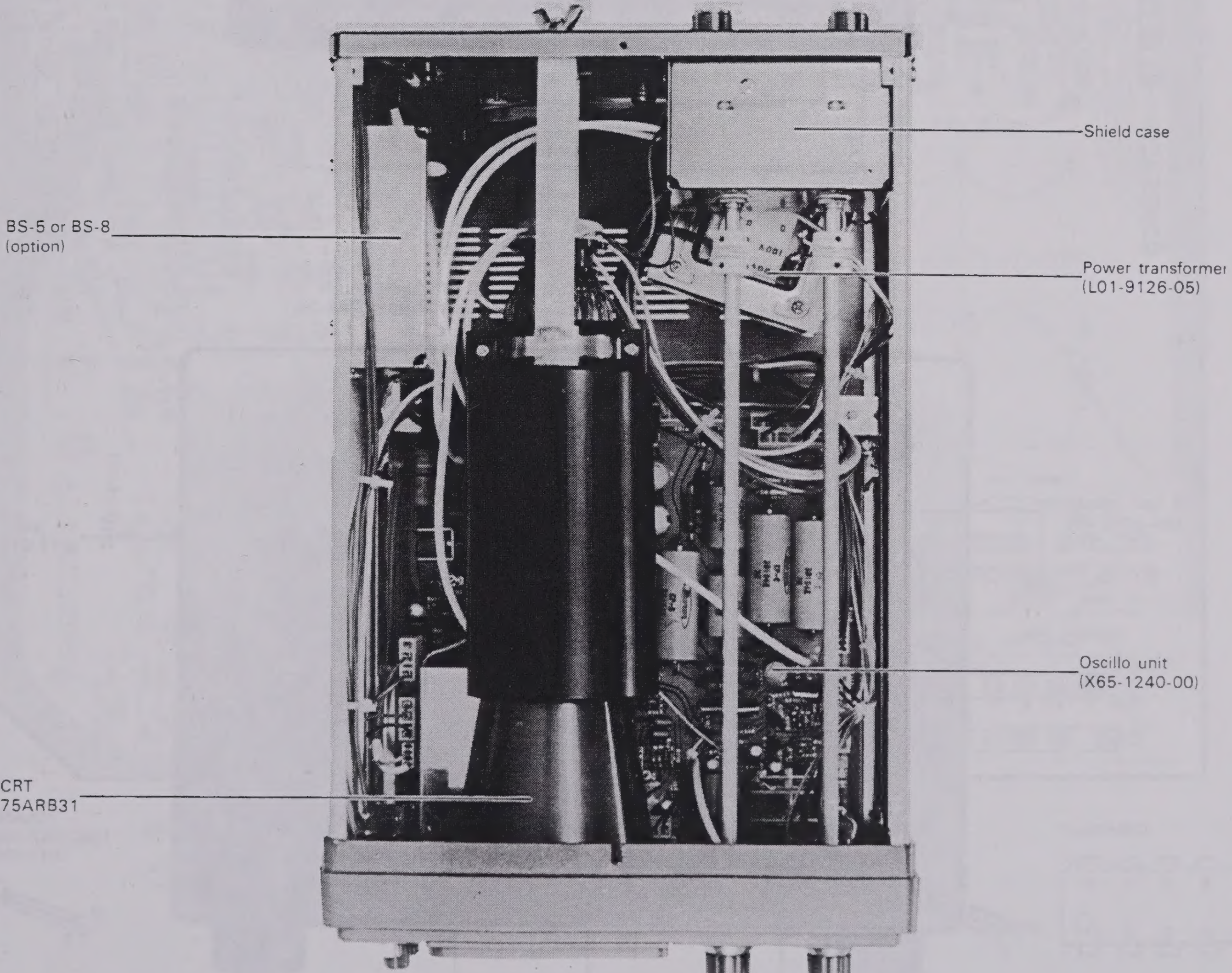
With the function switch in the MONITOR position, transmitted RF passes through the RF-IN/OUT circuit, is RF. attenuated and applied to the Y deflection plates. The attenuated signal is also detected and used as sync reference. When Trapezoid waveform is observed, modulated RF passing through the DRIVE IN/OUT circuit is detected and then applied to the horizontal amplifier.

5. TWO-TONE OSCILLATOR

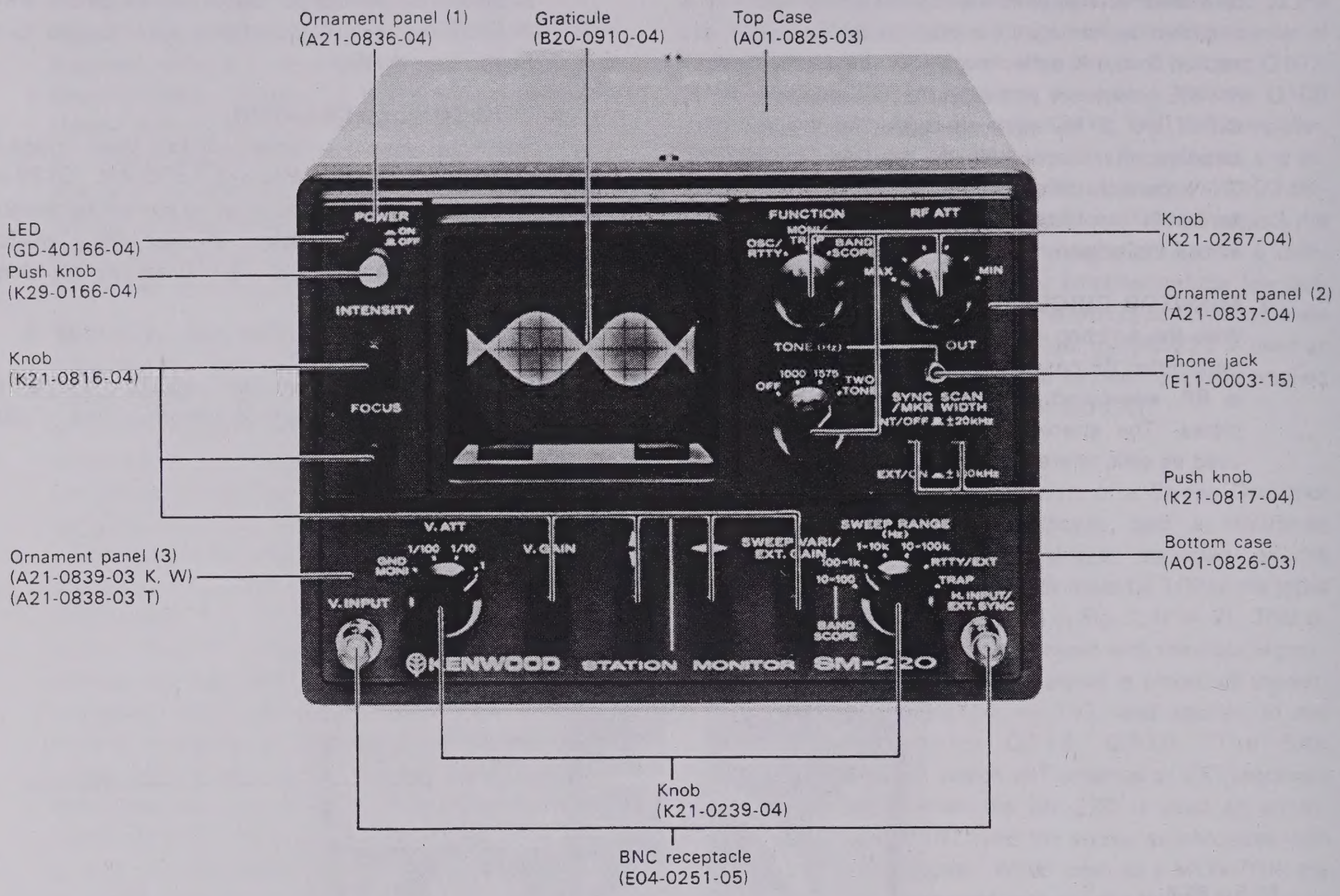
The tone generator consists of two Wien bridge oscillator operating at 1 kHz and 1,575 kHz. Q125 and Q126 act as feedback resistors to prevent temperature variation output fluctuation. VR-109 is the Two-Tone Balance adjustment and VR-110 adjusts the Output Level.

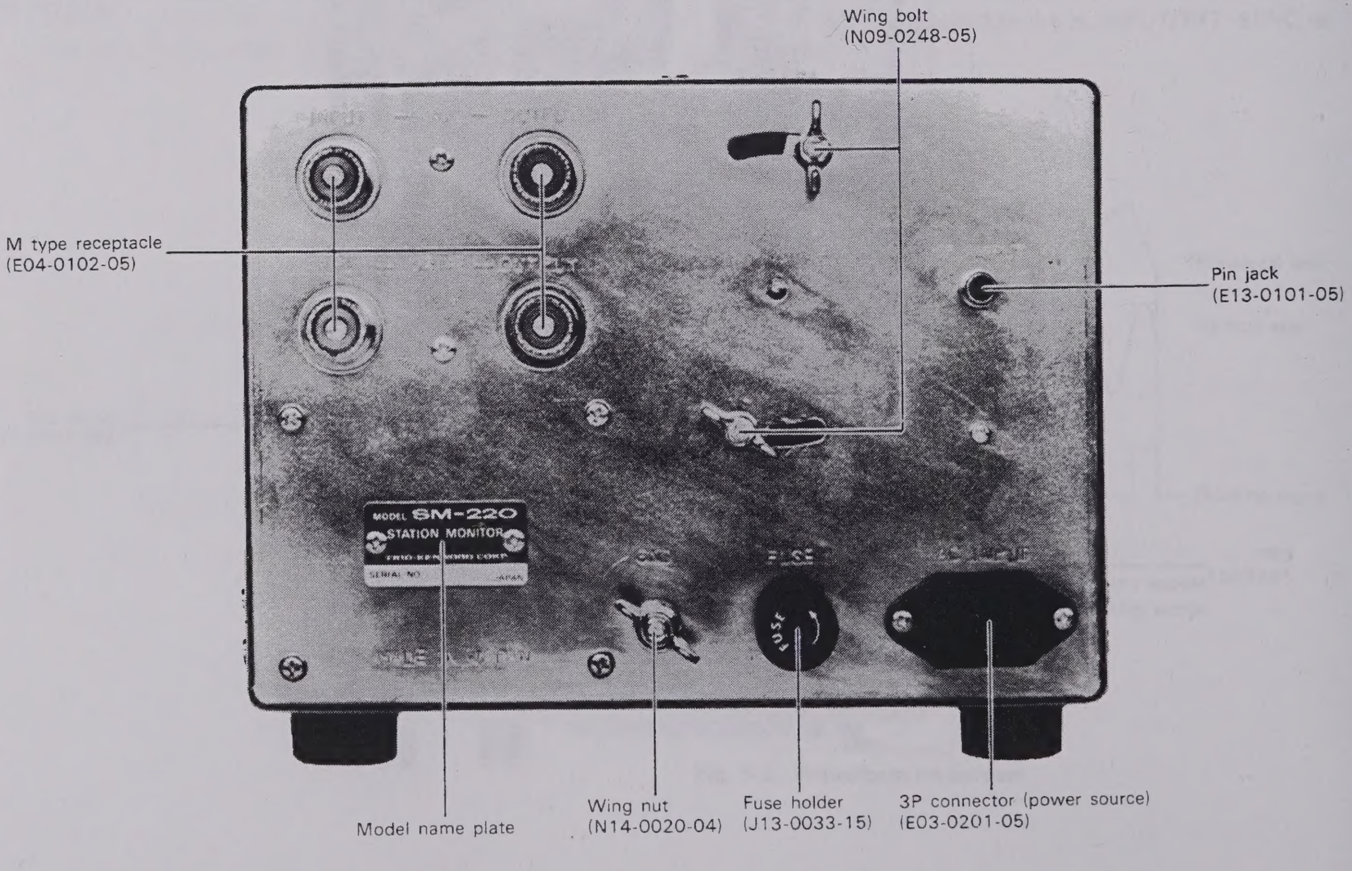
6. POWER SUPPLY

The Power Supply provides regulated +12V and −13V, +150V for the final amplifiers, and −1300V for the CRT.

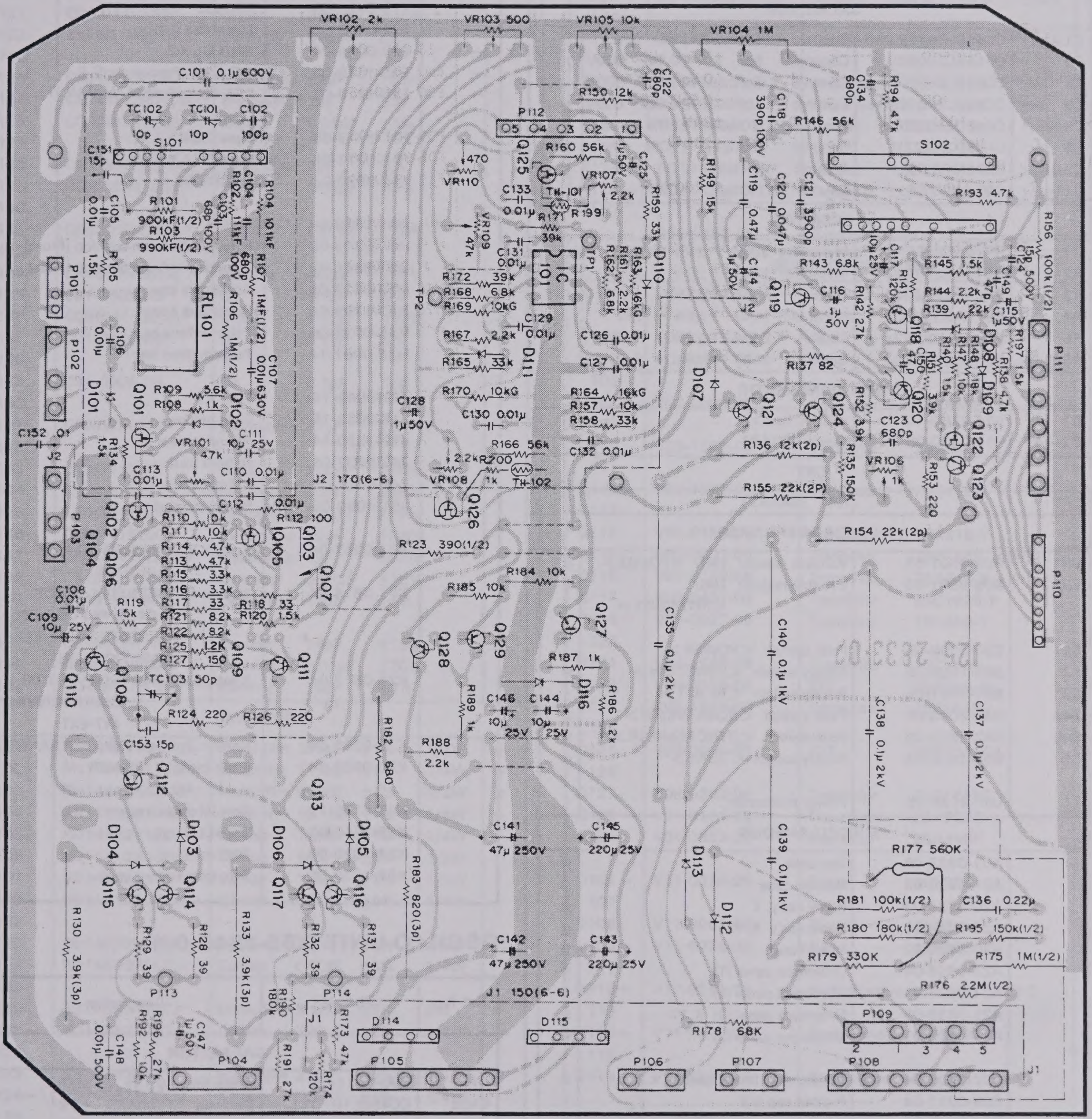


SECTION 6. VIEWS

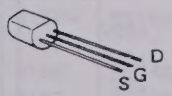




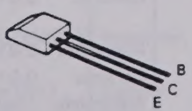
SECTION 7. PRINTED CIRCUIT BOARDS



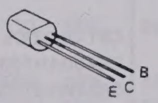
2SK30A(O)
2SK30A(O)(IDSS)
2SK30A(GR)



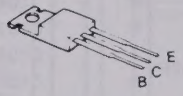
2SC535(B)



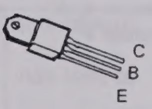
2SC1360



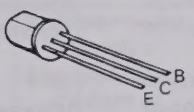
2SC1419C
2SA755C
2SC1569



2SA818Y
2SC1628Y



2SA495



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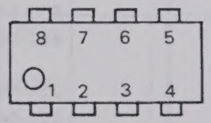


SECTION 8. PARTS LIST

GENERAL (Y71-1100-00)

☆ : New parts K ..... U.S.A, W ..... Europe, T ..... Britain

Ref. No.	Parts No.	Description	Re-marks
		CAPACITOR	
C1,2	CC45SL3D120JMU	Ceramic 12pF ±5% 2kV	
C3	CC45SL2H050D	Ceramic 5pF ±0.5pF 500V	
C4	CC45SL2H030D	Ceramic 3pF ±0.5pF 500V	
C5	CC45SL2H010D	Ceramic 1pF ±0.5pF 500V	
C6～7	CK45D2H103D	Ceramic 0.01μF ±20%	
C8	CK45D2H222M	Ceramic 0.0022μF ±20%	
C9,10	C90-0300-05	Ceramic 470pF	
C11	C91-0023-05	Ceramic 0.01μF AC250V	
		RESISTOR	
R1	RS14AB3F561J	Metal film 560Ω ±5% 3W	
R2	RS14AB3D103J	Metal film 10kΩ ±5% 2W	
R3	RD14BY2H222J	Carbon 2.2kkΩ ±5% 1/2W	
R4	RS14AB3D103J	Metal film 10kΩ ±5% 2W	
R5	RD14BY2H222J	Carbon 2.2kΩ ±5% 1/2W	
R6,7	RD14BY2H105J	Carbon 1MΩ ±5% 1/2W	
		SEMICONDUCTOR	
D1	V11-7200-10	LED <Red>	
D2～4	V11-0370-05	Diode 1S1587	
		CRT	
CRT		CRT 75ARB31	
		VR/SW/TRANSFORMER	
VR1	R05-8501-05	Variable resistor 1MΩ <FOCUS>	☆
VR2	R05-8501-05	Variable resistor 1MΩ <INTENSITY>	☆
S1	S39-2006-05	Push switch <POWER>	
S2	S01-1508-05	Rotary switch <FUNCTION>	☆
S3	S01-1501-05	Rotary switch <RF ATT>	
S4a	S42-2503-06	Push switch <SCAN WIDTH>	☆
S4b	S42-2503-05	Push switch <SYNC MARKER>	☆
S5	S01-1506-05	Rotary switch <TONE>	☆
T1	L01-9126-05	Power trnsformer	
		MISCELLANEOUS	
	A01-0825-03	Top case	☆
	A01-0826-03	Bottom case	☆
	A20-2724-03	Panel ass'y T	☆
	A20-2725-03	Panel ass'y K, W	☆
	A20-2726-02	Mold Panel	☆
	A21-0836-04	Ornament panel (1)	☆
	A21-0837-04	Ornament panel (2)	☆
	A21-0839-03	Ornament panel (3) K, W	☆
	A21-0838-03	Ornament panel (3) T	☆
	B07-0702-04	Escutcheon (Push switch) × 2	☆
	B09-0011-04	Rubber cap × 3	
	B20-0910-04	Graticule	☆
	B30-0707-05	Lamp ass'y	☆
	B46-0007-00	Warranty card	
	B50-2856-00	Operating manual K, W	☆
	B50-2857-00	Operating manual T	☆
	D21-0902-04	Shaft	☆
	D22-0402-05	Universal coupling	
	E01-1403-05	CRT socket	
—	E03-0201-05	3P connector (power source)	
—	E04-0102-05	M type receptacle × 4	
—	E04-0251-05	BNC receptacle × 2	
—	E11-0003-15	Phone jack	
—	E13-0101-05	Pin jack	
—	E22-0405-05	Lug strips × 2	
—	E23-0015-04	GND lug × 2	
—	E30-1818-05	JIS cord (Power cord) K	
—	E30-1819-05	CEE cord (Power cord) W, T	
	F05-5013-05	Fuse 0.5A × 2 K	
	F05-3011-05	Fuse 0.3A × 2 W, T	
	F11-0920-04	CRT shield	☆
	H01-2839-04	Carton	☆
	H01-2805-02	Polystyrene foam cushion [Front]	☆
	H01-2806-02	Polystyrene foam cushion [Rear]	☆
	H19-0503-03	Accessory box	☆
	H20-1709-04	Protective cover	☆
	H25-0029-04	Polyethylene bag	☆
	H25-0007-14	Polyethylene bag	
	J02-0049-14	Foot × 6	
	J13-0033-15	Fuse holder	
	J32-1030-14	Round boss × 2	
	J42-0002-05	Rubber bush	
	J42-0021-05	Rubber bush × 2	
	J61-0053-05	Board support × 2	
	K21-0267-04	Knob × 3 TONE, RF ATT, FUNCTION	
	K21-0816-04	Knob × 6 INTENSITY, FOCUS, V.GAIN, ◀▶ POSITION, ▲▼ POSITION, SWEEP VARI/EXT GAIN	☆
	K21-0817-04	Knob (push) × 2 SCAN WIDTH, MARKER/SYNC INT-EXT	☆
	K23-0239-04	Knob × 2 V. ATT, SWEEP RANGE	
	K29-0802-04	Knob (push) POWER	
	X42-1120-10	Coaxial cable ass'y	
	X65-1240-00	OSCILLO unit	
	X67-1020-00	BNC cord	
	X67-1070-00	Two tone output cord	

OSCILLO UNIT (X65-1240-00)

Ref. No.	Parts No.	Description	Re-marks
		CAPACITOR	
C101	C90-0021-05	Metal film 0.1μF 600V	☆
C102	CC45SL1H101J	Ceramic 100pF ±5%	
C103	CM93BD2A680J	Mica 68pF ±5%	
C104	CM93BD2A681J	Mica 680pF ±5%	
C105, 106	CK45D1H103M	Ceramic 0.01μF ±20%	
C107	C91-0502-05	Metal film 0.01μF 630V	☆
C108	CK45D1H103M	Ceramic 0.01μF ±20%	
C109	CE04W1E100	Electrolytic 10μF 25V	
C110	CK45D1H103M	Ceramic 0.01μF ±20%	
C111	CE04W1E100	Electrolytic 10μF 25V	
C112, 113	CK45D1H103M	Ceramic 0.01μF ±20%	
C114～116	CE04BW1H010M	Electrolytic 1μF 50V	
C117	CE04W1E100	Electrolytic 10μF 25V	

SECTION 8. PARTS LIST

Ref. No.	Parts No.	Description	Remarks
C118	CM03BD2A391J	Mica 390pF ±5%	
C119	CQ93M1H474K	Mylar 0.47μF ±10%	
C120	CQ93M1H473K	Mylar 0.047μF ±10%	
C121	CQ93M1H392K	Mylar 3900pF ±10%	
C122, 123	CK45D1H681M	Ceramic 680pF ±20%	
C124	CE04W1C470	Electrolytic 47μF 16WV	
C125	CE04BW1H010M	Electrolytic 1μF 50V	
C126, 127	CQ93M1H103J	Mylar 0.01μF ±5%	
C128	CE04BW1H010M	Electrolytic 1μF 50V	
C129, 130	CQ93M1H103J	Mylar 0.01μF ±5%	
C131～133	CK45D1H103M	Ceramic 0.01μF ±20%	
C134	CK45D1H681M	Ceramic 680pF ±20%	
C135	C91-0509-05	Oil 0.1μF 2kV	
C136	CQ93M1H224K	Mylar 0.22μF ±10%	
C137, 138	C91-0509-05	Oil 0.1μF 2kV	
C139, 140	C91-0506-05	Oil 0.1μF 1kV	
C141, 142	CE04W2E470	Electrolytic 47μF 250WV	
C143	CE04W1E221	Electrolytic 220μF 25WV	
C144	CE04W1E100	Electrolytic 10μF 25WV	
C145	CE04W1E221	Electrolytic 220μF 25WV	
C146	CE04W1E100	Electrolytic 10μF 25WV	
C147	CE04BW1H010M	Electrolytic 1μF 50WV	
C148	CK45D2H103M	Ceramic 0.01μF ±20%	
C149, 150	CC45SL1H470J	Ceramic 47pF ±5%	
C151	CC45SL2H150J	Ceramic 15pF ±15%	
C152	CK45D1H103M	Ceramic 0.01μF ±20%	
C153	CC45SL1H150J	Ceramic 15pF ±5%	
RESISTOR			
R101	RN14BK2H9003F	Metal film 199kΩ ±1% 1/2W	☆
R102	RN14BK2E1113F	Metal film 111kΩ ±1% 1/4W	☆
R103	RN14BK2H9903F	Metal film 990kΩ ±1% 1/2W	☆
R104	RN14BK2E1012F	Metal film 10.1kΩ ±1% 1/4W	☆
R105	RD14BB2E152J	Carbon 1.5kΩ ±5% 1/4W	
R106	RD14BY2H105J	Carbon 1MΩ ±5% 1/2W	
R107	RD14BK2H1004F	Carbon 1MΩ ±1% 1/2W	
R108～122	RD14BB2E○○○J	Carbon ○○○Ω ±5% 1/4W	
R123	RD14BY2H391J	Carbon 390Ω ±5% 1/2W	
R124～129	RD14BB2E○○○J	Carbon ○○○Ω ±5% 1/4W	
R130	RS14GB3F392J	Metal film 3.9kΩ ±5% 3W	☆
R131～132	RD14BB2E390J	Carbon 39Ω ±5% 1/4W	
R133	RS14GB392J	Metal film 3.9kΩ ±5% 3W	☆
R134～135	RD14BB2E○○○J	Carbon ○○○Ω ±5% 1/4W	
R136	RS14GB3D123J	Metal film 12kΩ ±5% 1/2W	☆
R137～153	RD14BB2E○○○J	Carbon ○○○Ω ±5% 1/4W	
R154～155	RS14GB3D○○○J	Metal film ○○○Ω ±5% 2W	☆
R156	RD14BY2H104J	Carbon 100kΩ ±5% 1/2W	
R157～162	RD14BB2E○○○J	Carbon ○○○Ω ±5% 1/4W	
R163～164	RN14BK2E○○○G	Metal film ○○○Ω ±2% 1/4W	☆
R165	RN14BB2E333J	Carbon 33kΩ ±5% 1/4W	
R166～168	RD14BB2E○○○J	Carbon ○○○Ω ±5% 1/4W	
R169～170	RD14BK2E○○○J	Carbon ○○○Ω ±5% 1/4W	
R171～174	RD14BB2E○○○J	Carbon ○○○Ω ±5% 1/4W	
R175～181	RD14BY2H○○○J	Carbon ○○○Ω ±5% 1/2W	
R182	RS14GB3D122J	Metal film 1.2kΩ ±5% 2W	☆
R183	RS14GB3F821J	Metal film 820Ω ±5% 3W	☆
R184～194	RD14BB2E○○○J	Carbon ○○○Ω ±5% 1/4W	
R195	RD14BY2H154J	Carbon 150kΩ ±5% 1/2W	
R196～197	RD14BB2E○○○J	Carbon ○○○Ω ±5% 1/4W	
	R92-0150-05	Jumper resistor × 17	
SEMICONDUCTOR			
IC101	V30-0217-05	IC NJM4558D	☆
Q101	V09-0015-05	FET 2SK30A-0	
Q102～103	V09-9981-05	FET 2SK30A-0 (Idss)	
Q104～109	V03-0098-05	Transistor 2SC535B	
Q110～111	V03-1360-06	Transistor 2SC1360	☆
Q112～113	V03-1569-06	Transistor 2SC1596	☆
Q114	V01-0153-06	Transistor 2SA818-Y	
Q115	V03-0401-05	Transistor 2SC1628	
Q116	V01-0153-05	Transistor 2SA818-Y	
Q117	V03-0401-05	Transistor 2SC1628-Y	
Q118～120	V01-0037-05	Transistor 2SA496-Y	
Q121	V03-1569-06	Transistor 2SC1569	☆
Q122	V09-0015-05	FET 2SK30A-0	
Q123, 124	V03-1569-06	Transistor 2SC1569	☆
Q125, 126	V09-0060-05	FET 2SK30A-GR	
Q127	V03-0343-05	Transistor 2SC1419C	
Q128	V01-0114-05	Transistor 2SA755C	
Q129	V01-0037-05	Transistor 2SA495Y	
D101～107	V11-0076-05	Diode 1S1555	
D108	V11-0051-05	Diode 1N60	
D109～111	V11-0076-05	Diode 1S1555	
D112～113	V11-0288-05	High pressure diode HVT-22Z-3	
D114～115	V11-0410-05	Diode (bridge) S1QB60	
D116	V11-0249-05	Zener diode WZ-120	
TH101, 102	V22-0033-05	Thermister SDT-100	
SWITCH/TRIMMER			
VR101	R12-1004-05	Semi-fixed resistor 4.7kΩ <DC.BAL>	
VR102	R03-1020-05	Semi-fixed resistor 2kΩ (C) <V.GAIN>	
VR103	R01-0505-05	Semi-fixed resistor 500Ω (B) <V.POS.>	
VR104	R03-8050-05	Semi-fixed resistor 1MΩ (B) <SWEEP VAR. H. GAIN>	
VR105	R01-2503-05	Semi-fixed resistor 10kΩ (B) <H.POS.>	

SECTION 8. PARTS LIST

Ref. No.	Parts No.	Description	Remarks
VR106	R12-1002-05	Semi-fixed resistor 1kΩ <H. GAIN>	
VR107~108	R12-1003-05	Semi-fixed resistor 2.2kΩ	
VR109	R12-3004-05	Semi-fixed resistor 470kΩ	
VR110	R12-0003-05	Semi-fixed resistor 470Ω	
TC101, 102	C05-0404-05	Trimmer (Ceramic) 10pF	
TC103	C05-0029-15	Trimmer (Ceramic) 50pF	
		SWTICH/RELAY	
S101	S01-1507-05	Rotary switch <V.ATT>	☆
S102	S01-2505-05	Rotary switch <SWEEP RANGE>	☆
PL101	S51-1506-05	Relay	☆
		MISCELLANEOUS	
	E23-0046-04	Terminal × 6	
	E23-0508-04	Terminal [test point] × 2	

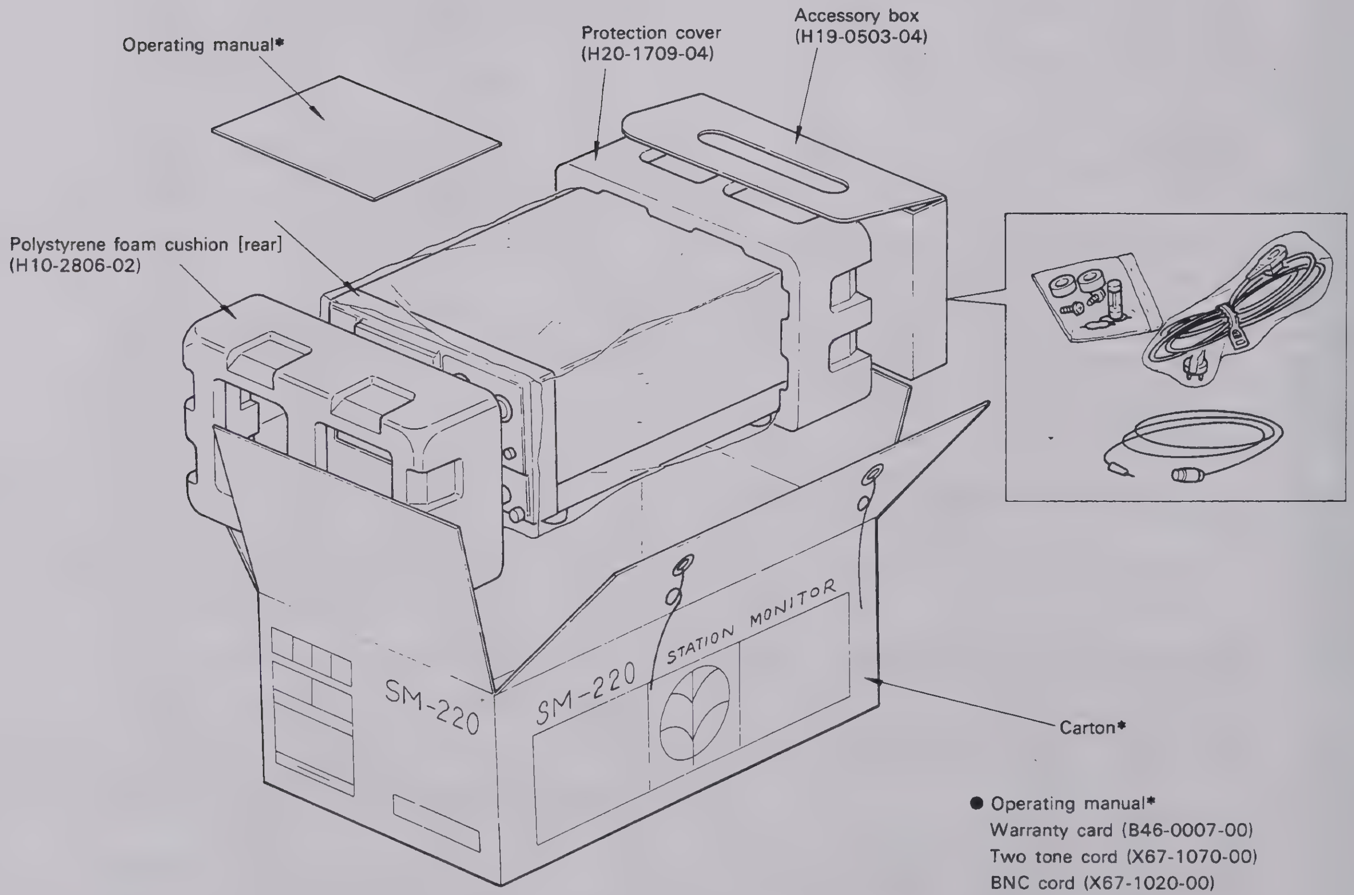
BNC CORD (CA-41) (X67-1020-00)

Ref. No.	Parts No.	Description	Remarks
—	E05-0357-05	BNC plug	☆
—	E91-0003-05	Alligator clip (black)	
—	E91-0004-05	Alligator clip (Red)	
—	060-0002-05	Coaxial cable	
—	H25-0016-00	Polyethylene bag	

TWO TONE CORD (X67-1070-00)

Ref. No.	Parts No.	Description	Remarks
—	E07-0403-05	Round plug	
—	E12-0001-05	Phone plug	
—	J42-0506-04	Rubber tube	

SECTION 9. PACKING


Operating manual*
Protection cover (H20-1709-04)
Accessory box (H19-0503-04)
Polystyrene foam cushion [rear] (H10-2806-02)
SM-220
SM-220 STATION MONITOR
Carton*

- Operating manual*
  Warranty card (B46-0007-00)
  Two tone cord (X67-1070-00)
  BNC cord (X67-1020-00)
  Power cord (supplied)*
  Coaxial cable Ass'y (X42-1120-10)
  Polyethylene bag
  1. Foot (w/screw) (J02-0049-14) × 2
  2. Fuse (spare) (F05-5013-05)
  3. Resistor 10kΩ, 150Ω

* See parts list

SECTION 10. DISASSEMBLY

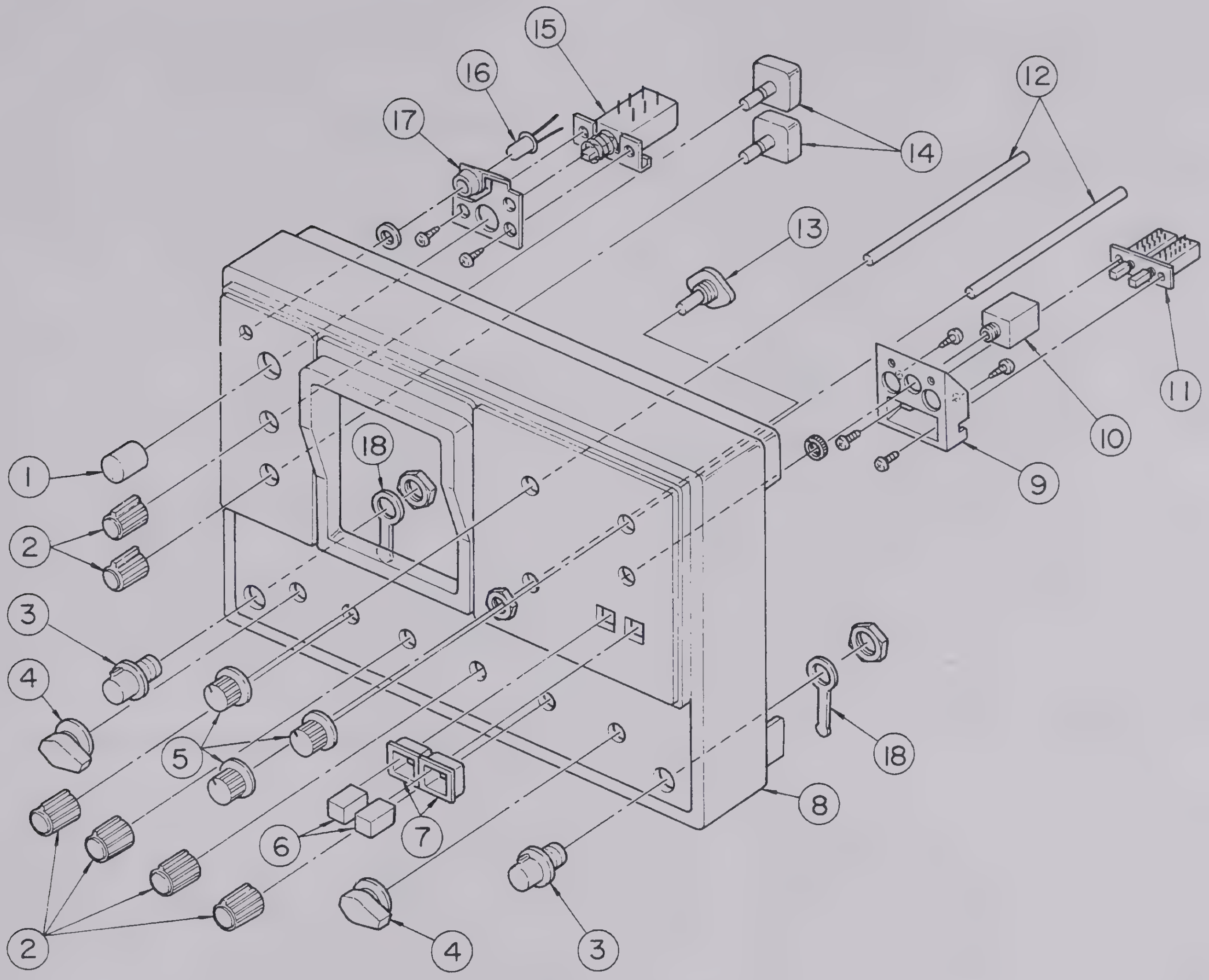


Fig. 10-1 Front Panel Disassembly

No.	Parts Name	Parts No.	Remarks	No.	Parts Name	Parts No.	Remarks
1	Knob (push)	K29-0166-04	POWER	10	Phone jack	E11-0003-05	TONE OUT
2	Knob	K21-0816-04	INTENSITY, FOCUS, V.GAIN SYNC/MKR, SCAN WIDTH	11	Push switch	S42-2503-05	SYNC/MKR, SCAN WIDTH
3	BNC receptacle	E04-0251-05	H.INPUT H.INPUT	12	Shaft	D21-0902-04	
4	Knob	K21-0239-04	V.ATT SWEEP RANGE	13	Rotary switch	S01-1506-05	TONE
5	Knob	K21-0267-04	FUNCTION, RFATT, TONE	14	Variable resistor	R05-8501-05	FOCUS, INTENSITY
6	Knob (push)	K21-0817-04	SYNC/MKR, SCAN WIDTH	15	Power switch	S39-2006-05	POWER
7	Eschtcheon (push)	B07-0702-04		16	Lamp ass'y	B30-0907-05	
8	Panel ass'y	A20-2724-03		17	Switch fittings		
9	Switch fittings			18	GND lug	E23-0015-04	

SECTION 10. DISASSEMBLY

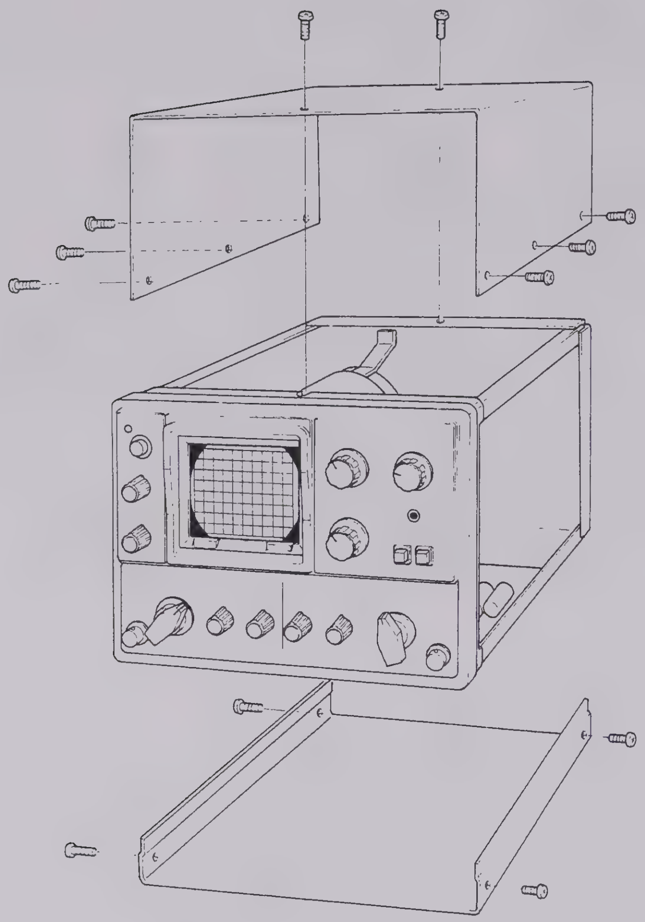


Fig. 10-2 Case Removal

1. GRATICULE REMOVAL/INSTALLATION

Press at Fig. 10-3 arrows, and withdraw upward and out.

To reinstall, insert the bottom edge of the graticule between the front panel and the CRT, and then direct the top edge in toward the CRT.

2. CRT REMOVAL

1) Remove screws "A".
2) Loosen screws "B" and remove the CRT socket.
3) Shift the CRT to the rear arrow, and then withdraw the CRT and its fittings upward and out.

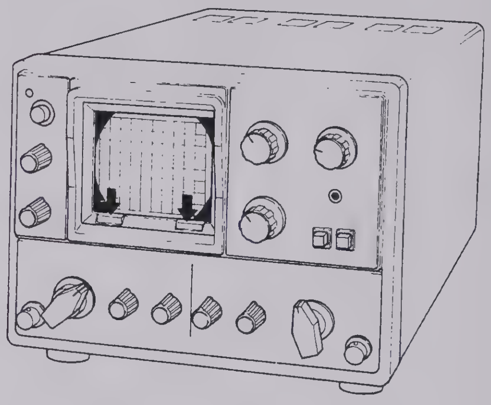


Fig. 10-3 Graticule Removal/Installation

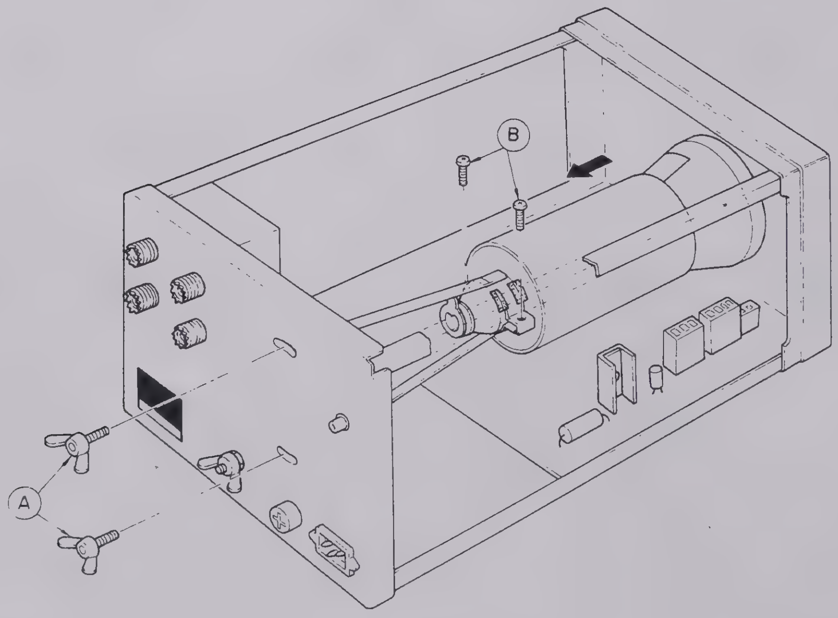


Fig. 10-4 CRT Removal

SECTION 11. ADJUSTMENT

- **Test Equipment Required**

1. **AC (Audio Generator)**
   Sine and squarewave generator than 5V at 1KHz.
2. **AF VTVM**
   Range: 10 mV ~ 10V
3. **HF-SG (Signal Generator)**
   Output 100 KHz and 12 MHz.
4. **Oscilloscope**
   Frequency response generator 5 MHz, 20 mV sensitivity.

   NOTE: SM-220 itself can be used.

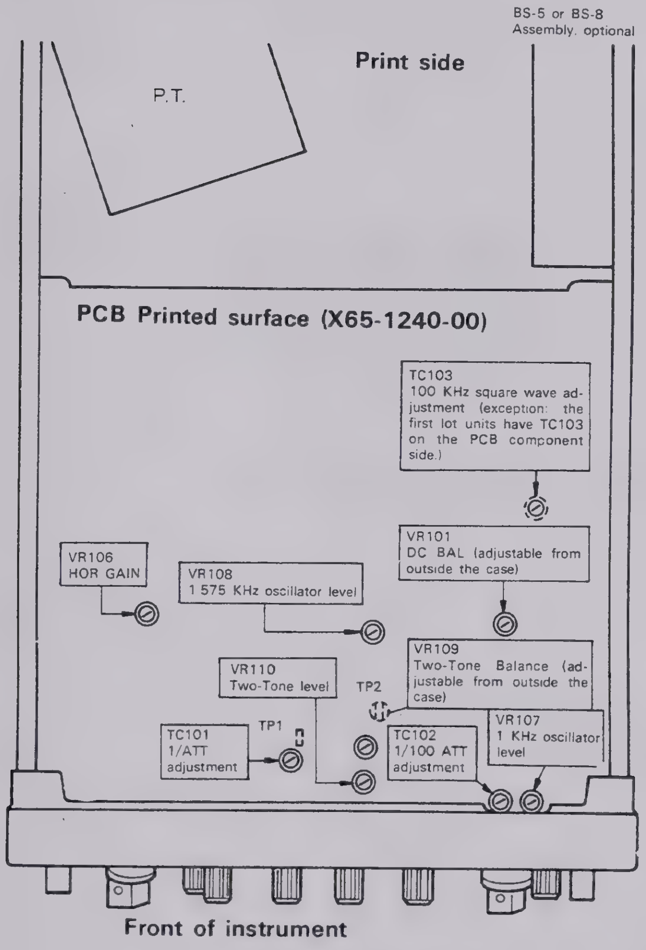

BS-5 or BS-8
Assembly, optional
Print side
P.T.
PCB Printed surface (X65-1240-00)
TC103
100 KHz square wave adjustment (exception: the first lot units have TC103 on the PCB component side.)
VR106
HOR GAIN
VR108
1 575 KHz oscillator level
VR101
DC BAL (adjustable from outside the case)
VR109
Two-Tone Balance (adjustable from outside the case)
VR110
Two-Tone level
TP2
TP1
TC101
1/ATT
adjustment
TC102
1/100 ATT
adjustment
VR107
1 KHz oscillator
level
Front of instrument

Fig. 11-1 Adjustment

- **Adjustment Procedure**

(Adjustments are shown in Fig. 11-1)

1. **DC Balance VR-101**

   (Adjustable from the bottom of the case)

   If vertical amplifier DC balance is not maintained, the trace or waveform will shift vertically when the V. GAIN is adjusted.

   1) Place the V. ATT to GND/MONITOR and adjust the V. GAIN fully counterclockwise. Adjust the ⬍ Position so the trace is centered.
   2) Adjust the GAIN fully clockwise. Adjust the DC Bal VR101 until the trace returns to the screen center.
   3) Repeat this procedure two or three times until the trace remains stationary when the V. GAIN is adjusted.

   NOTE: Perform this procedure after the unit stabilites, about 15 minutes.

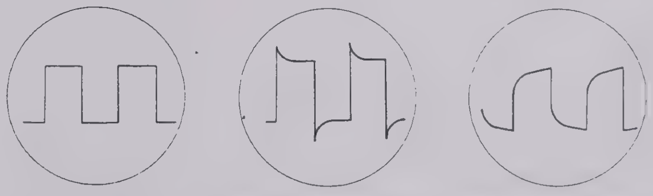
2. **Horizontal Gain VR-106**

   Place the SWEEP RANGE control in the 10—100 Hz position. If the trace does not fully extend over the screen, adjust the HOR. GAIN VR-106 as follows.

   1) Place the SWEEP RANGE control in the RTTY/EXT position and turn the SWEEP VAR/EXT GAIN control fully clockwise.
   2) Apply a 1 kHz, 3V signal to the H. INPUT/EXT SYNC terminal. Adjust VR-106 for a trace length of 10 divs.

3. **Vertical Attenuator (V. ATT) Frequency Response**

   1) Apply a 1 kHz square wave at approximately 50 mV, to the V. INPUT terminal. Set the V. ATT to 1 and the SWEEP RANGE to 100—1 kHz. Adjust the V. GAIN and SWEEP VARI/EXT GAIN for square wave amplitude of approximately 6 divs, and 2 ~ 4 cycles displayed. Check that the ideal waveform (as shown in Fig. 11-2) is displayed.



Ideal Waveform　Excessive Trimmer Capacity (Overshoot)　Insuficient Trimmer Capacity (Undershoot)

Fig. 11-2 V. ATT High-Frequency Response Compensation

SECTION 11. ADJUSTMENT

2) Set the V. ATT to 1/10 and increase the AG output level by 20 dB. Adjust TC101 for ideal waveform.
3) Set the V. ATT to 1/100 and increase the AG output level by 20 dB. Adjust TC102 for ideal waveform. Fig. 11-2 shows the relationship between waveform and trimmer capacity.

4. High-Frequency Response Adjustment

If high-frequency response is not adjusted properly, peaks may appear around 5 ~ 10 MHz, or gain may drop off at high-frequency.

1) Set the V. ATT to 1, V. GAIN fully clockwise, and SWEEP RANGE to 10—100 KHz. Apply an unmodulated 100 KHz signal at ±90 dB (.35V) to the V. INPUT terminal. Adjust the SG output level for a 6 div. display.
2) Change the SG output frequency to 12 MHz and adjust TC103 for a 4.2 div display.

5. Tone Oscillator Levels

(1) VR107, VR108

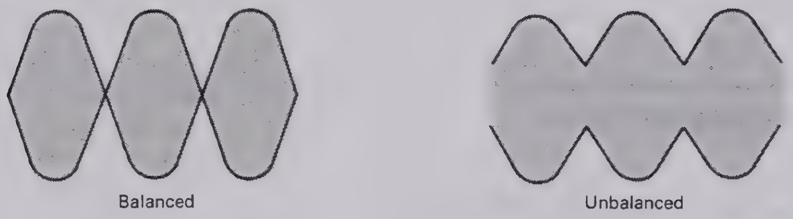
Place the TONE switch in the 1000 Hz position. Adjust VR107 for 3Vp-p (1V rms) at (test point) TP1. Then, place the TONE switch in the 1575 Hz position and adjust VR108 for 3Vp-p (WRMS) at TP2.

(2) Two-Tone Balance VR109

Adjust VR109 (Tone Balance) for dqual output is at both the 1000 Hz and 1575 Hz switch settings, measured at the TONE OUTPUT terminal (±7.5 mV each tone setting).

(3) Tone Output VR110

Adjust VR110 (Output Level) for 10 mV in the TWO-TONE mode, measured at the TONE OUTPUT terminal.



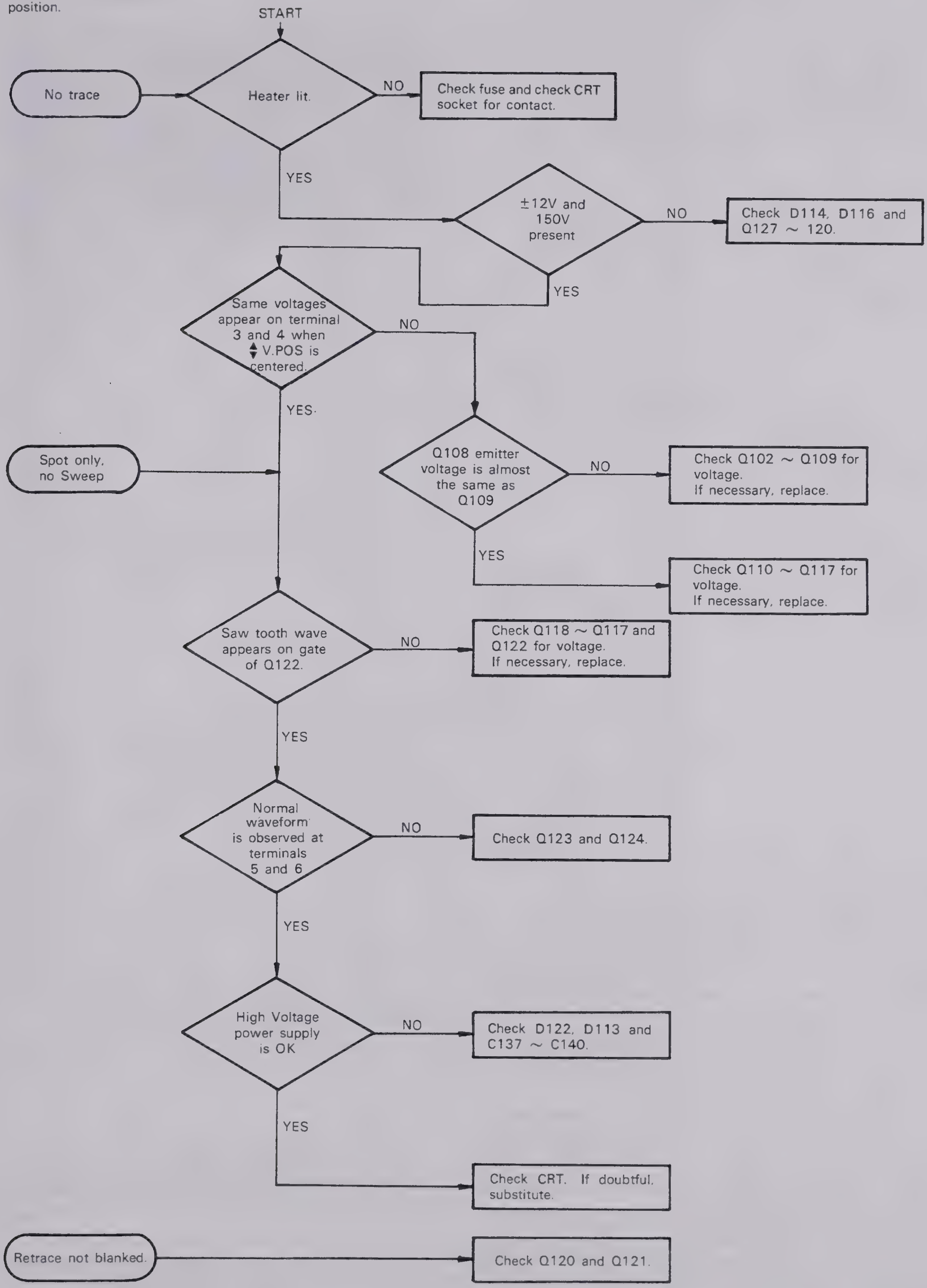
Balanced

Unbalanced

Fig. 11-3 Two-Tone Oscillator Balance Adjustment

SECTION 12. TROUBLESHOOTING

Turn the power switch On and place the Function Switch in the Oscilloscope position.


START
No trace
Heater lit.
NO
Check fuse and check CRT socket for contact.
YES
±12V and 150V present
NO
Check D114, D116 and Q127 ~ 120.
YES
Same voltages appear on terminal 3 and 4 when ⬍ V.POS is centered.
NO
YES
Spot only, no Sweep
Q108 emitter voltage is almost the same as Q109
NO
Check Q102 ~ Q109 for voltage. If necessary, replace.
YES
Check Q110 ~ Q117 for voltage. If necessary, replace.
Saw tooth wave appears on gate of Q122.
NO
Check Q118 ~ Q117 and Q122 for voltage. If necessary, replace.
YES
Normal waveform is observed at terminals 5 and 6
NO
Check Q123 and Q124.
YES
High Voltage power supply is OK
NO
Check D122, D113 and C137 ~ C140.
YES
Check CRT. If doubtful, substitute.
Retrace not blanked.
Check Q120 and Q121.

SECTION 13. PAN DISPLAY OPTION

GENERAL

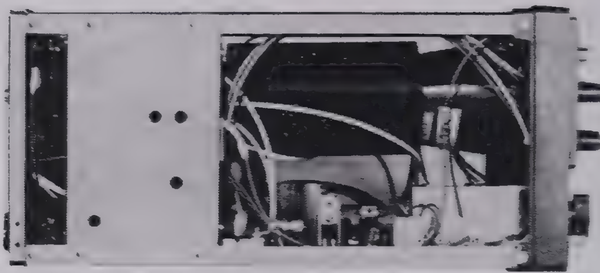
To monitor signal conditions in the vicinity of your receive frequency, a Pan Display Plug-In is available as an option to the SM-220.

TS-520S series	BS-5
TS-820S series	BS-8

The BS-5 is designed to match the TS-520 series IF frequency 3395 KHz, and the BS-8 the TS-820 series IF frequency 8833 KHz.

When using either the BS-5 or BS-8, a minor wiring addition is required in the transceiver.

The Pan Display is easily installed in the SM-220, and requires no soldering-A11 connections are accomplished by multiconnectors.



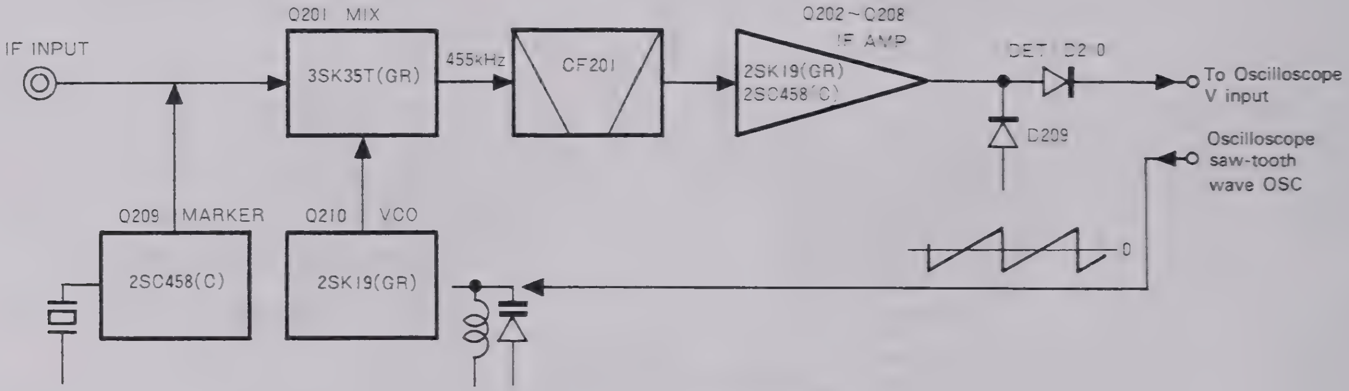


Fig. 13-1 Block Diagram

DESCRIPTION OF THE BS-5 AND BS-8

When the BS-5 or BS-8 is installed in the SM-220 and connected to the transceiver, signal conditions in the vicinity of the receive frequency can be displayed over a ±20 KHz or ±100 KHz range. The Pan Display amplifier employs a logarithmic compression system, so weak and strong signals can be monitored simultaneously. The narrow bandwidth filter permits monitoring of adjacent signals even under adverse receiving conditions, in both SSB and CW modes.

Model	FX-1082
Center Frequency	455 kHz
Insertion Loss	7 dB ± 1 dB
Band Width	More than 1.0 kHz/−6 dB Less than 3.0 kHz/−60 dB
Guaranty Attenuation	More than 60 dB at 455 ±100 kHz

CERAMIC FILTER RATINGS

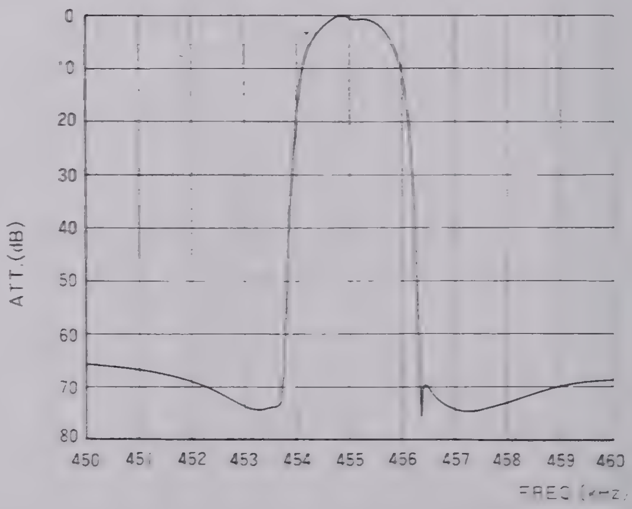
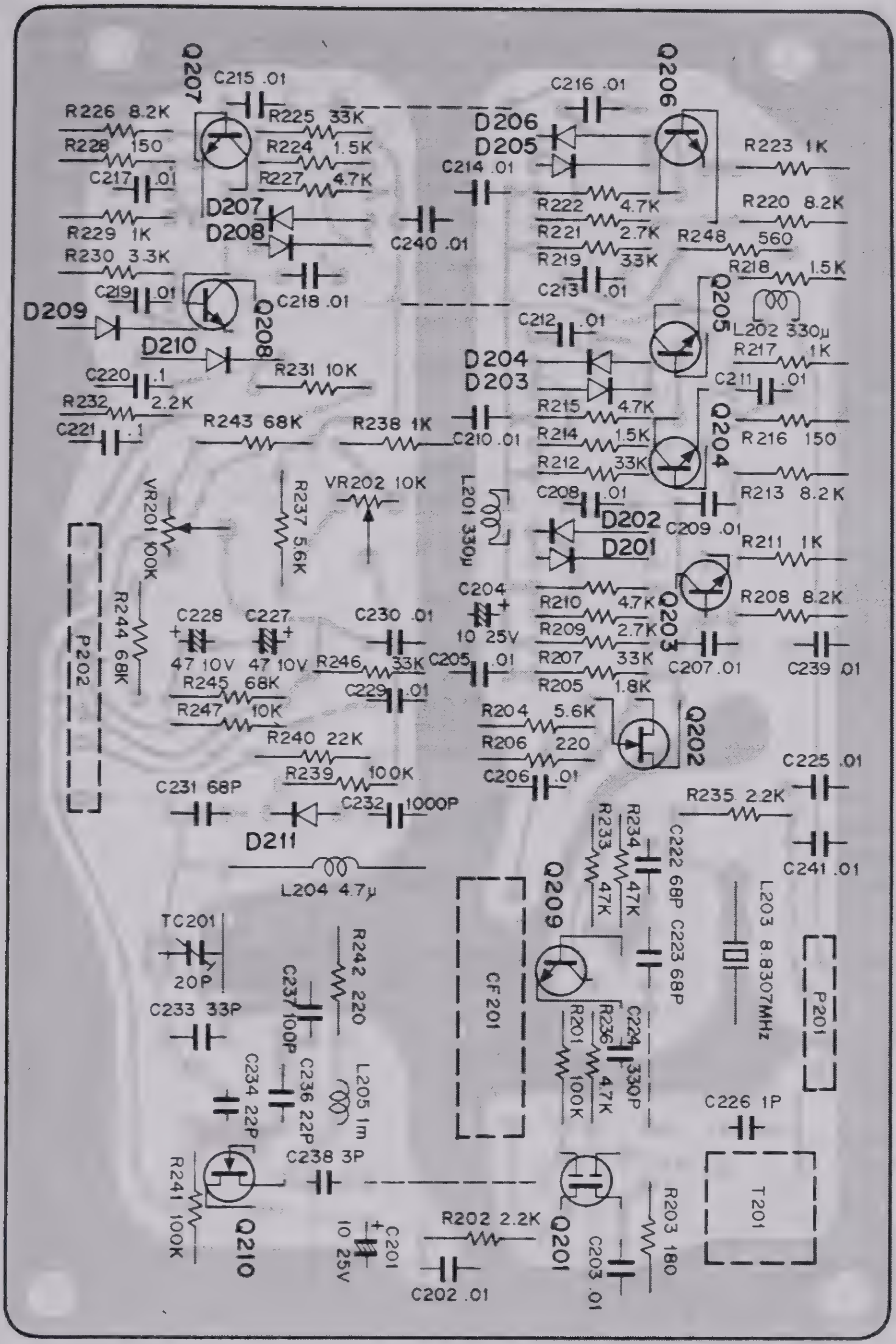
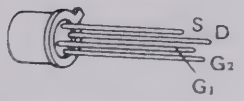


Fig. 13-2 Ceramic Filter Frequency Characteristics

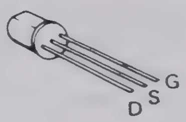
PC BOARD



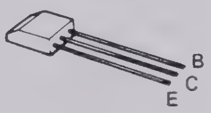
3SK35T(GR)



2SK19(GR)



2SC458(C)



BS-8 UNIT (X65-1250-00)
BS-5 UNIT (X65-1250-01)

COMPARATIVE TABLE

Refer to Parts List and Schematic Diagram.

	C231	C232	C233	C234	C236	C237	L203	L204	T201
BS-8	68pF	1000pF	33pF	22pF	22pF	100pF	8.8307MHz	4.7μH	L34-0527-05
BS-5	1000pF	0.01μF	—	100pF	47pF	680pF	3.395MHz	20μH	L31-0286-05

PARTS LIST

GENERAL

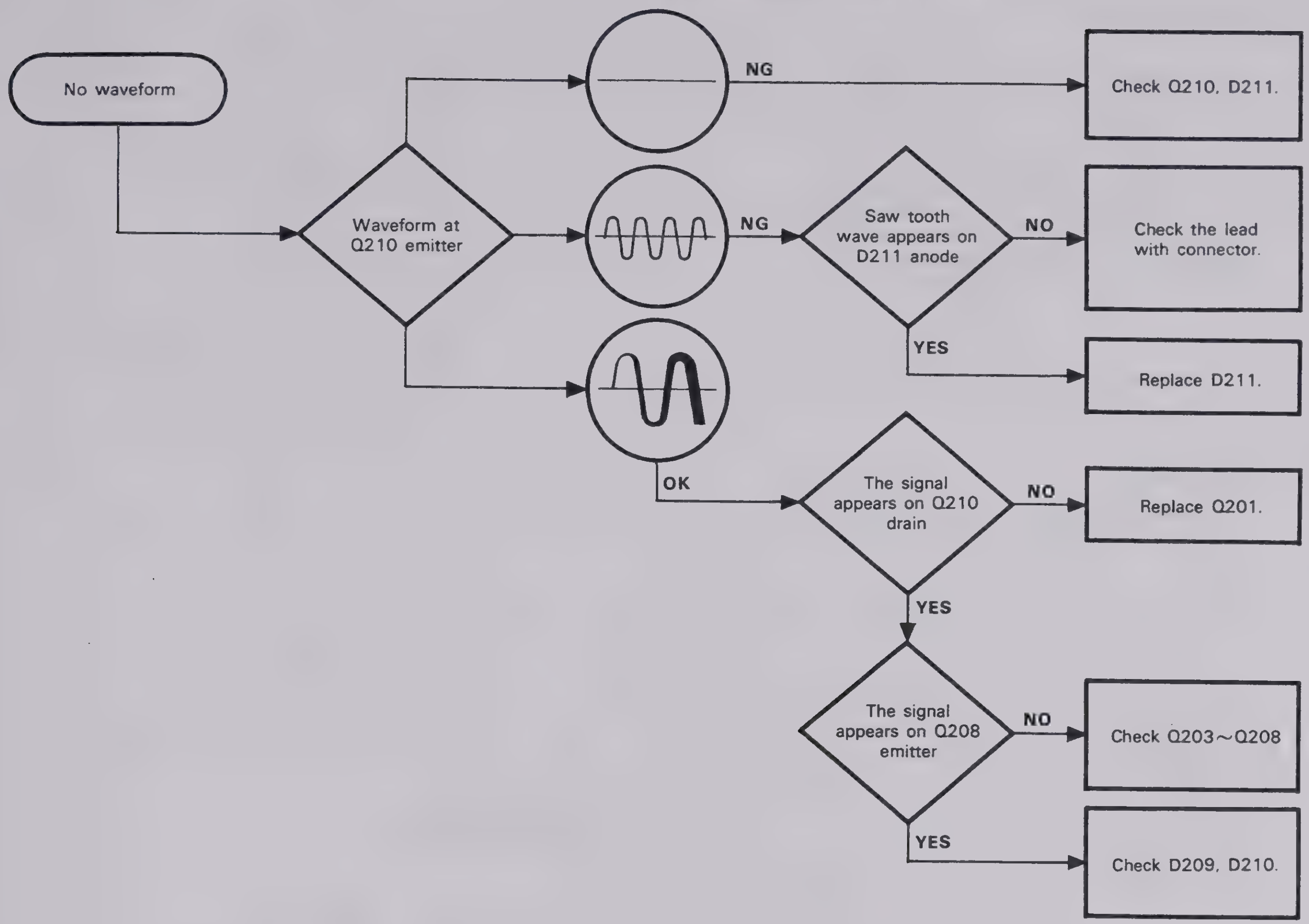
☆ : New parts

Ref. No.	Parts No.	Description	Re-marks
—	CC45SL1H470J	Ceramic 47pF ±5% **BS-8**	
—	CC45SL1H101J	Ceramic 100pF ±5% **BS-5**	
—	B20-0909-04	Graticule	☆
—	B58-0903-00	Caution card	☆
—	E30-1828-05	Cord with pin plug	☆
—	E31-0573-05	Lead with connector	☆
—	H01-2842-03	Carton case **BS-8**	☆
—	H01-2844-03	Carton case **BS-8**	☆
—	H25-0016-00	Polyethylene bag	
—	H25-0029-04	Polyethylene bag	
—	J61-0053-05	Board support × 4 LCBS-4	
—	N35-3006-46	Bind screw × 8	
—	001-0801-05	Plated lead × 5 **BS-8**	
—	060-3001-05	Coaxial cable 1.5D-XV	
—	X65-1250-00	BS-8 unit **BS-8**	☆
—	X65-1250-01	BS-5 unit **BS-5**	☆

BS-8 UNIT (X65-1250-00)
BS-5 UNIT (X65-1250-01)

Ref. No.	Parts No.	Description	Re-marks
C201	CE04W1E100	Electrolytic 10μF 25WV	
C202, 203	CK45D1H103M	Ceramic 0.01μF ±20%	
C204	CE04W1E100	Electrolytic 10μF 25WV	
C205～219	CK45D1H103M	Ceramic 0.01μF ±20%	
C220, 221	C90-0298-05	Ceramic 0.01μF	
C222, 223	CC45SL1H680J	Ceramic 68pF ±5%	
C224	CK45D1H331M	Ceramic 330pF ±20%	
C225	CK45D1H103M	Ceramic 0.01μF ±20%	
C226	CC45SL1H010D	Ceramic 1pF ±0.5pF	
C227, 228	CE04W1A470	Electrolytic 47μF 10WV	
C229, 230	CE45D1H103M	Ceramic 0.01μF ±20%	
C231	CC45CH1H680J	Ceramic 680pF ±5% **BS-8**	
	CK45D1H102M	Ceramic 1000pF ±20% **BS-5**	
C232	CK45D1H102M	Ceramic 1000pF ±20% **BS-8**	
	CK45D1H103M	Ceramic 0.01μF ±20% **BS-5**	
C233	CC45CH1H330J	Ceramic 33pF ±5% **BS-8** **BS-5**	
C234	CC45CH1H220J	Ceramic 22pF ±5% **BS-8**	
	CC45CH1H101J	Ceramic 100pF ±5% **BS-5**	
C235			
C236	CC45CH1H220J	Ceramic 22pF ±5% **BS-8**	
	CC45CH1H470J	Ceramic 47pF ±5% **BS-5**	
C237	CC45CH1H101J	Ceramic 100pF ±20% **BS-8**	
	CK45D1H681M	Ceramic 680pF ±20% **BS-5**	
C238	CC45SL1H030D	Ceramic 3pF ±0.5pF	
C239～241	CK45D1H103M	Ceramic 0.01μF ±20%	
R201～	RD14BB2E○○○J	Carbon ○○○Ω ±5% 1/4W Refer to schematic diagram.	
—	R92-0150-05	Jumper resistor × 4	
Q201	V09-1002-26	FET 3SK35(T)(GR)	
Q202	V09-0012-05	FET 2SK19(GR)	
Q203～209	V09-0080-05	Transistor 2SC458(C)	
Q210	V09-0012-05	FET 2SK19(GR)	
D201～208	V11-0076-05	Diode 1S555	
D209, 210	V11-0051-05	Diode 1N60	
D211	V11-0447-05	Diode 1SV50	
VR201	R12-5002-05	Semi-fixed resistor 100kΩ	
VR202	R12-3002-05	Semi-fixed resistor 10kΩ	
TC201	C05-0013-15	Trimmer 20pF	
L201, 202	L40-3311-03	Ferri-inductor 330μH	
L203	L77-0487-05	Crystal 8.8307 MHz **BS-8**	
	L77-0123-05	Crystal 3.395 MHz **BS-5**	
L204	L33-0801-05	Choke coil 4.7μH **BS-8**	
	L33-0265-05	Choke coil 20μH **BS-5**	
L205	L40-1025-04	Ferri-inductor 1 mH	
T201	L34-0527-05	IFT **BS-8**	
	L31-0286-05	IFT **BS-5**	
CF201	L72-0401-05	Ceramic filter	
P201	E40-0414-05	4P connector	
P202	E40-0914-05	9P connector	

TROUBLE SHOOTING/INSTLLATION


No waveform
Waveform at Q210 emitter
NG
Check Q210, D211.
NG
Saw tooth wave appears on D211 anode
NO
Check the lead with connector.
YES
Replace D211.
OK
The signal appears on Q210 drain
NO
Replace Q201.
YES
The signal appears on Q208 emitter
NO
Check Q203～Q208
YES
Check D209, D210.

ADJUSTMENTS/PACKING

INSTALLATION

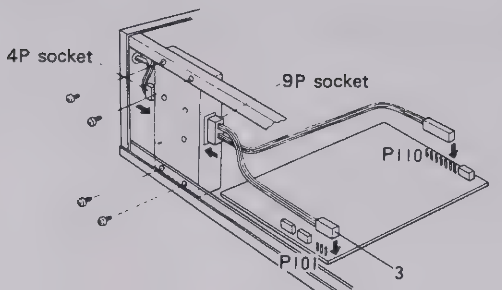


Fig. 13-3 BS-5, BS-8 Installation

ADJUSTMENT

The BS-5 or BS-8 must be adjusted before use. For adjustment, the antenna must be disconnected from the transceiver.

1. Set the SM-220 FUNCTION switch to BAND SCOPE (Pan Display).
2. Depress the MARKER switch ON, center the display by the ◀▶ POSITION control and center the V. GAIN control. Adjust the ▲ POSITION to shift the trace to the bottom of the graticule. With the SCAN WIDTH set to the WIDE 100 KHz position, turn the scan width adjustment VR202 until the marker signal moves to the scope center line.
3. Turn the MARKER OFF. Set the tranceiver RF GAIN to MAX, and the FUNCTION switch to CAL 25 KHz and peak the drive control for MAX "S" meter reading. At this time, check that 8-10 waveform peaks ("SPIKES") appear on the CRT screen, as shown in Fig. 13-5B. If necessary, reset the center frequency adjustment trimmer TC201 and the scan width adjustment VR202 (STEP2), until the waveform shown in Fig. 13-5A is obtained.

NOTE: Make certain you have actually adjusted the center frequency to the receiver. If necessary, find a single signal to verify this adjustments

4. Turn off the 25 KHz calibrator, turn on the marker. Set the SCAN WIDTH to the NARROW (20 KHz) position, and adjust VR201 for CENTERED marker display, as previously outlined is step 2.

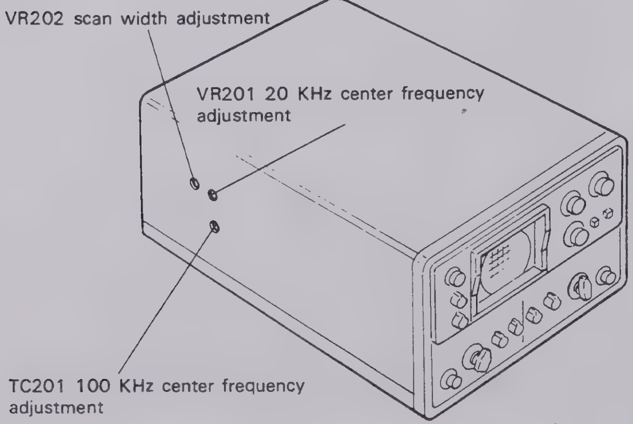
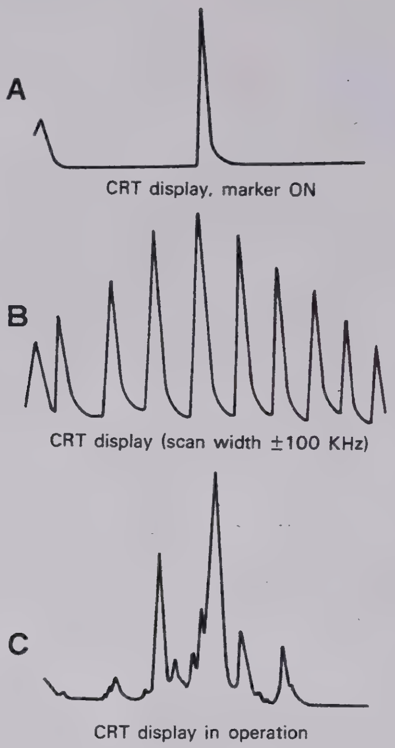

VR202 scan width adjustment
VR201 20 KHz center frequency adjustment
TC201 100 KHz center frequency adjustment

Fig. 13-4 Pan Display Adjustment



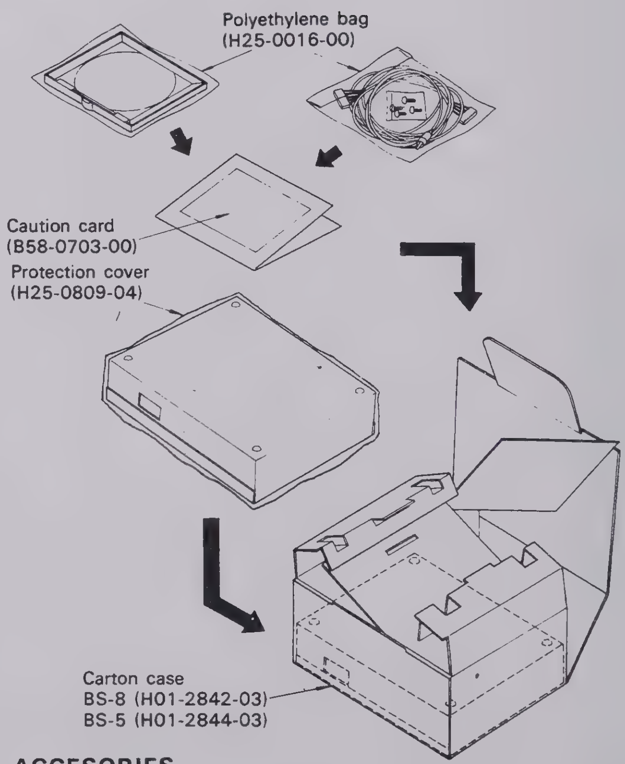
CRT display, marker ON

CRT display (scan width ±100 KHz)

CRT display in operation

Fig. 13-5 Pan Display Waveforms

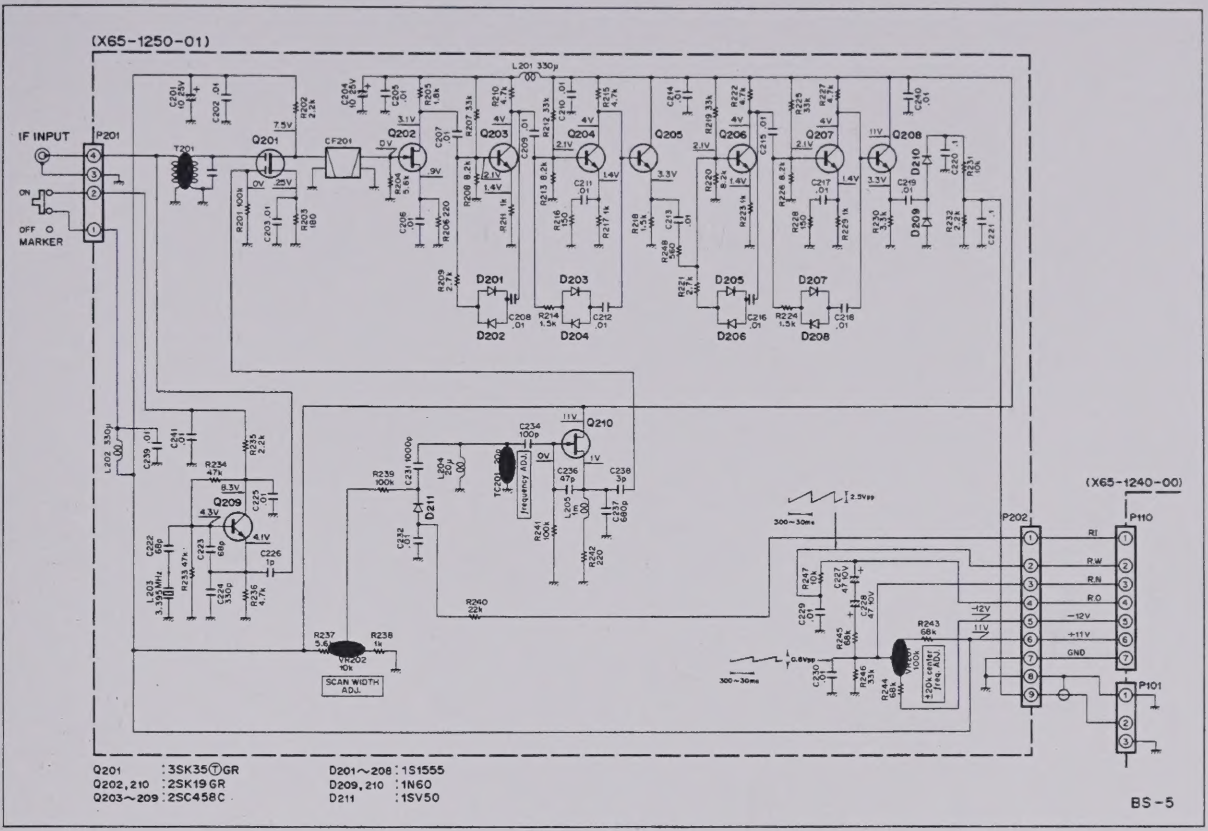
PACKING

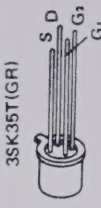


ACCESORIES

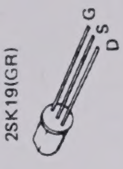
Caution card (B58-0703-00)
Graticule (B20-0909-04)
Cord with pin plug (E30-1828-05)
Lead with connector (E31-0573-05)
Bind screw × 4 (N35-3006-46)
Pick-up cord (060-3001-05)

BS-5 SCHEMATIC DIAGRAM

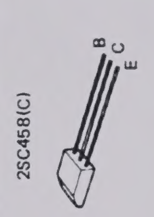




3SK35T(GR)

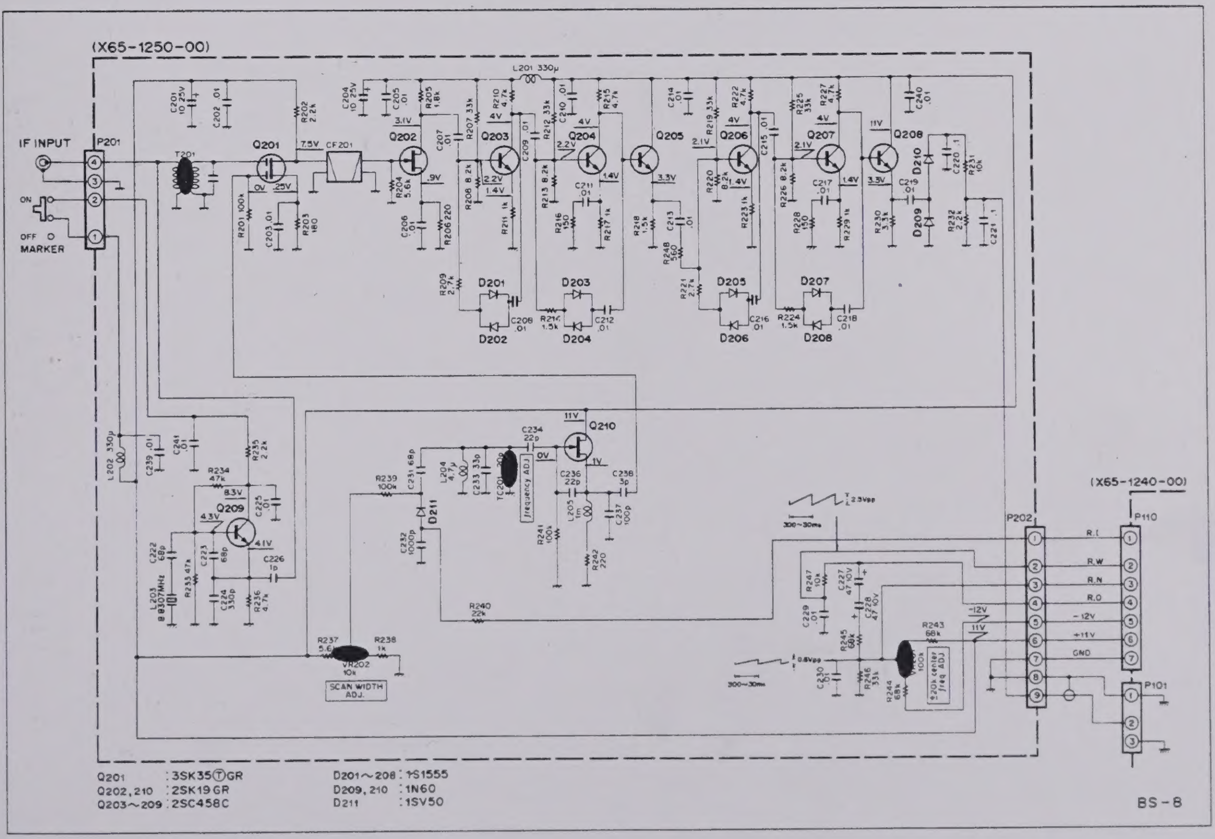


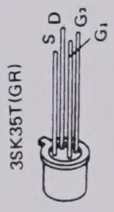
2SK19(GR)



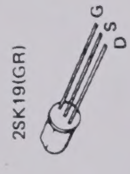
2SC458(C)

BS-8 SCHEMATIC DIAGRAM

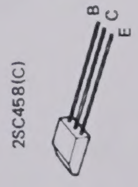




3SK35T(GR)



2SK19(GR)



2SC458(C)

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